# CHAPTER 4
# SEWER CAPACITY EVALUATION

## 4.1 INTRODUCTION

An evaluation of the available capacity in the City's existing wastewater collection system was completed to identify sewer reaches that may be undersized to accommodate existing and/or future wastewater flows. Based on findings of the evaluation, phased facility improvements were identified to reduce the potential for sanitary sewer overflows as well as to allow for projected growth within the City's service area.

This chapter describes the analytical methodology and model development, and summarizes the findings of the evaluation.

### Background

As part of previous sewer basin studies completed by the City, separate hydraulic models were developed of the Telegraph Canyon (2002), Poggi Canyon (2002), and Salt Creek (2003) Trunk Sewers. The hydraulic analysis performed as part of the Master Plan and presented herein utilized these three existing models as well as an additional model developed for those basins not included in the existing Telegraph Canyon, Poggi Canyon, or Salt Creek models. The new model is referred to as the North-West Sewer Model based on the relative location of the modeled basins within the City. Figure 4-1 shows the areas included in each of the models.

### Evaluation Objectives

The objectives of the sewer capacity evaluation include:

- Develop hydraulic models of the City's wastewater collection system (generally pipes 12-inch in diameter and larger)
- Identify sewer reaches that may be overcapacity under existing and projected future peak wastewater loading conditions
- Based on the findings of the hydraulic analysis, recommend improvements to the existing collection system to reduce the potential for sanitary sewer overflows and to allow for planned growth within the City's service area

### Scope of Work

The scope of the sewer capacity evaluation consists of (1) update of existing hydraulic models of the Telegraph Canyon, Poggi Canyon, and Salt Creek Trunk Sewers, and development of a dynamic flow model of the sewer collection system (generally pipes 12-inch in diameter and larger) not included in the existing hydraulic models; (2) calibration of the new model; (3) simulation of existing and future flow conditions; and (4) recommendation of facility improvements based on hydraulic analysis. The detailed GIS data collected as part of the model development task was formatted and provided to the City for incorporation into the City's utility database.

Note that the four models used in the capacity evaluation incorporate slightly dissimilar wastewater loading methodology (i.e. unit generation factors were applied to land use classifications differently) since the models were developed independently of each other. The model results have been verified through calibration to field conditions, either as part of this capacity evaluation or in previous studies completed by the City, and therefore, the loading basis for the models was not revised as part of the evaluation.

## 4.2 METHODOLOGY

The principal tool utilized in the capacity analysis was a hydraulic model that simulates flow conditions, such as wastewater flow depth, flow rate, and velocity, within selected pipes and manholes in the City's wastewater collection system. The model selected for use in this study, XP-SWMM (XP Software, Version 8.0) belongs to a class of models referred to as dynamic wave models. These models provide an accurate simulation of hydraulic flow conditions over an extended period of time.

Data required to create the model include information describing the physical wastewater collection system, such as pipe diameters and reach lengths, manhole invert elevations, and estimated pipe roughness coefficients. Additionally, data describing the sewage loading at selected manholes, expressed as a varying flow rate over time (i.e. a diurnal curve), must be provided. Model output consists of a variety of hydraulic parameters, most importantly peak flow depths and discharge rates.

Physical system data, including manhole locations and invert elevations, pipe length and slope, and ground surface profiles were obtained from record drawings and construction plans. Manhole tributary basins were delineated through examination of the City's geographic information system (GIS), and through inspection of tentative maps and improvement plans for new or planned development.

Calibration of the models consisted of simulating existing sewer flow conditions and comparing the modeled and recorded flows at ten locations including six permanent METRO metering stations and four temporary meters installed as part of the Master Plan. The assumed diurnal curves and unit generation rates for varying land use classifications that serve as input to the model were iteratively adjusted until the simulated and recorded wastewater flow and depth hydrographs matched to within a reasonable level of accuracy.

Simulations of future sewage flow conditions were performed by developing input data sets, which included sewage generation projections for buildout of the City's service area based on current General Plan land use designations. Pipe reaches in which simulated peak flow depths exceeded specified trigger criteria were identified as potential improvement reaches. Improvements required to provide adequate capacity for projected flows were then determined through an iterative modeling process. The process consisted of simulating flow conditions after increasing the diameter of downstream portions of the identified reaches. In subsequent iterations, additional lengths of pipe were increased in diameter until the projected peak flow could be conveyed through the reach without exceeding a specified design flow depth.

## 4.3 FLOW MONITORING

Flow records from various locations within the City's collection system were used to calibrate hydraulic model parameters and as a basis for estimates of future wastewater generation. The City of San Diego maintains permanent flow meters at each of the 12 locations where City sewers discharge to either City of San Diego or County of San Diego trunk sewers. These meters continuously record flow depth and velocity measurements. In addition, eight temporary flow meters were installed at selected manholes for a two-week period between May 23 and June 5, 2003. This period included the Memorial Day holiday. Meter locations are shown in Figure 4-2. A summary of the temporary meter data is provided in Appendix E.

## 4.4 INFLOW AND INFILTRATION

Infiltration is water that enters sewers from the ground through such means as defective pipes, pipe joints, connections, and manhole walls. Inflow is water that enters the sewer through roof, yard, and other drains (usually illicit connections), cross connections with storm drains, and manhole covers. Depending on the local groundwater and soil conditions, infiltration into the sewer system may occur for relatively long periods following rainfall events as water percolates through the soil. In some instances, high water tables may result in a constant base flow comprised of groundwater that has infiltrated into the system. Inflow is usually directly associated with rainfall events, and may result in large, rapid flow increases in the collection system.

A general assessment of inflow and infiltration in the City's collection system was made by evaluating flow records collected at selected METRO metering sites including CV-1 (Main Street, Date-Faivre, and Poggi Basins), CV-2 (Telegraph Canyon Basin), CV-3 (G Street Basin), and CV-7 (Sweetwater Basin) during the months of January and February 2003. The metering period included two large storm events that occurred February 11 through February 14 and February 25 through February 27 with total precipitation recorded at San Diego Lindberg Field of 3.0 inches and 1.85 inches, respectively.

Analysis of 15-minute interval flow measurements taken during the storm events indicated that large volumes of inflow entered the collection system in the CV-1 and CV-2 drainage basins.

Measured inflow volumes at these meters amounted to between 20 and 40 percent of the peak dry weather flow recorded at each meter. Small or negligible inflow volumes were observed in the CV-7 drainage basin. Meter data recorded at CV-3 was inconclusive in regards to inflow volumes due to wide fluctuations in antecedent flow measurements.

Average daily flow rates recorded at each of the meters were used to estimate the rainfall-dependant infiltration into the system. The largest infiltration response was observed following the February 11 – 14 storm event with the CV-1 and CV-2 basins exhibiting a slower response than the CV-3 basin. The CV-7 basin showed small or negligible rainfall-dependant infiltration. The average flow immediately following the February 11 storm was compared to the average weekday flows for the 5-week period preceding the storm. The difference between the pre- and post storm flows represent the approximate volume of combined infiltration and inflow into the system due to rainfall. The increases for each meter basin were approximately 19 percent for the CV-1 basin, 13 percent for the CV-2 basin, 11 percent for the CV-3 basin, and 7 percent for the CV-7 basin. Figures 4-3 through 4-6 illustrate the average flow records for each meter and impacts to the flow from infiltration.

Based on data compiled by the American Association of Civil Engineers (Manual No. 37, 1979) the average inflow and infiltration rate for municipal sanitary sewer systems is approximately 500 gpd per inch diameter per mile. Based on this rate the expected rainfall-dependant inflow and infiltration into the City's collection system would range from 10 to 15 percent of the average dry weather flow rate, which is consistent with the above findings.

Since the objective of the hydraulic analysis was to analyze capacity impacts due to expected rainfall-dependant infiltration only, that is not to evaluate large volume inflows due to causes such as open manhole covers or cleanouts, unknown drain connections, or major pipe failures, a constant infiltration rate equal to 10 percent of the average dry weather flow rate was modeled to account for wet-weather infiltration. It is recommended that the City continue to evaluate possible causes of large volume inflows, particularly in the western drainage basins, through such measures as focused metering studies, smoke tests in areas of suspected illicit connections, and on-going field inspections of remote manholes and sewer mains.

## 4.5 LIMITATIONS OF MODELING

The hydraulic models, which were utilized as the primary planning tool for the sewer capacity analysis, provide an accurate simulation of actual flow conditions within a sanitary sewer system in response to existing and future sewage loading. The accuracy of the simulation, however, is directly related to the accuracy of the model input data, including physical parameters and sewage loading projections. For example, in a case where roots had entered the sewer causing a blockage, the model would be unable to predict a resulting surcharge condition. Consequently, a general understanding of the data sources is critical in interpreting the modeling results.

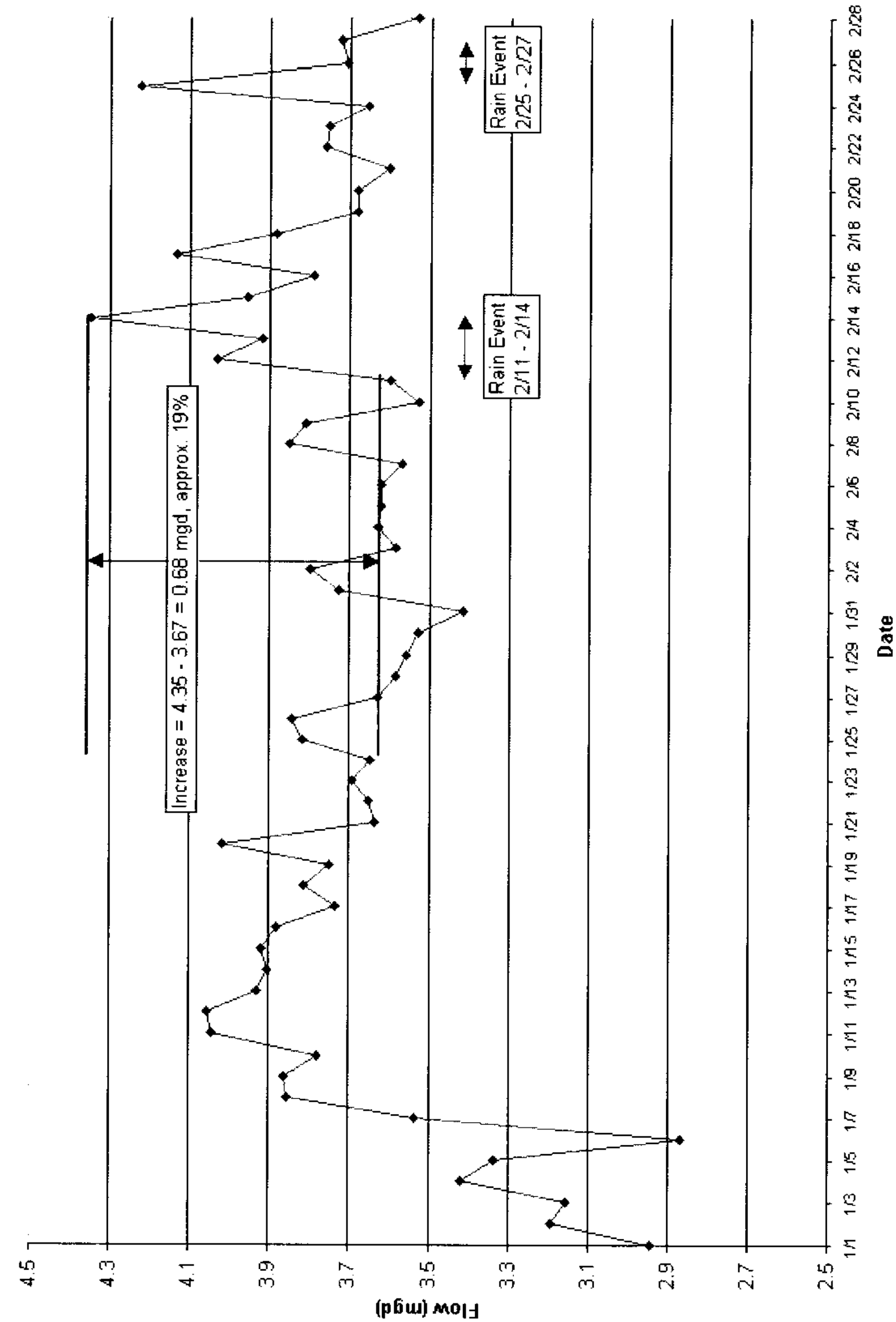


**Figure 4-3. Inflow and Infiltration Analysis – CV-1 Meter Average Flow Record**
**January 1, 2003 - February 28, 2003**

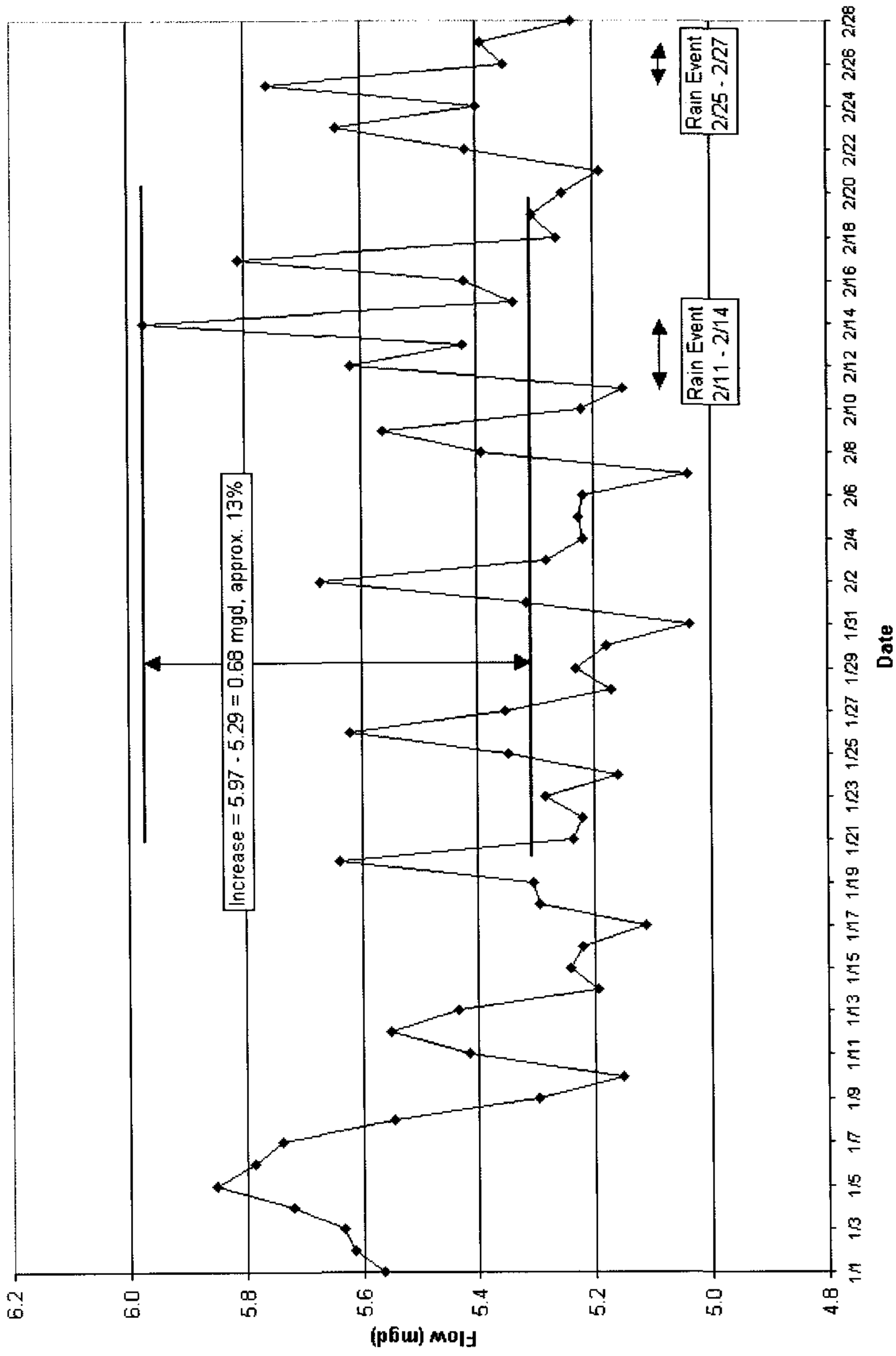


**Figure 4-4. Inflow and Infiltration Analysis – CV-2 Meter Average Flow Record**
**January 1, 2003 - February 28, 2003**

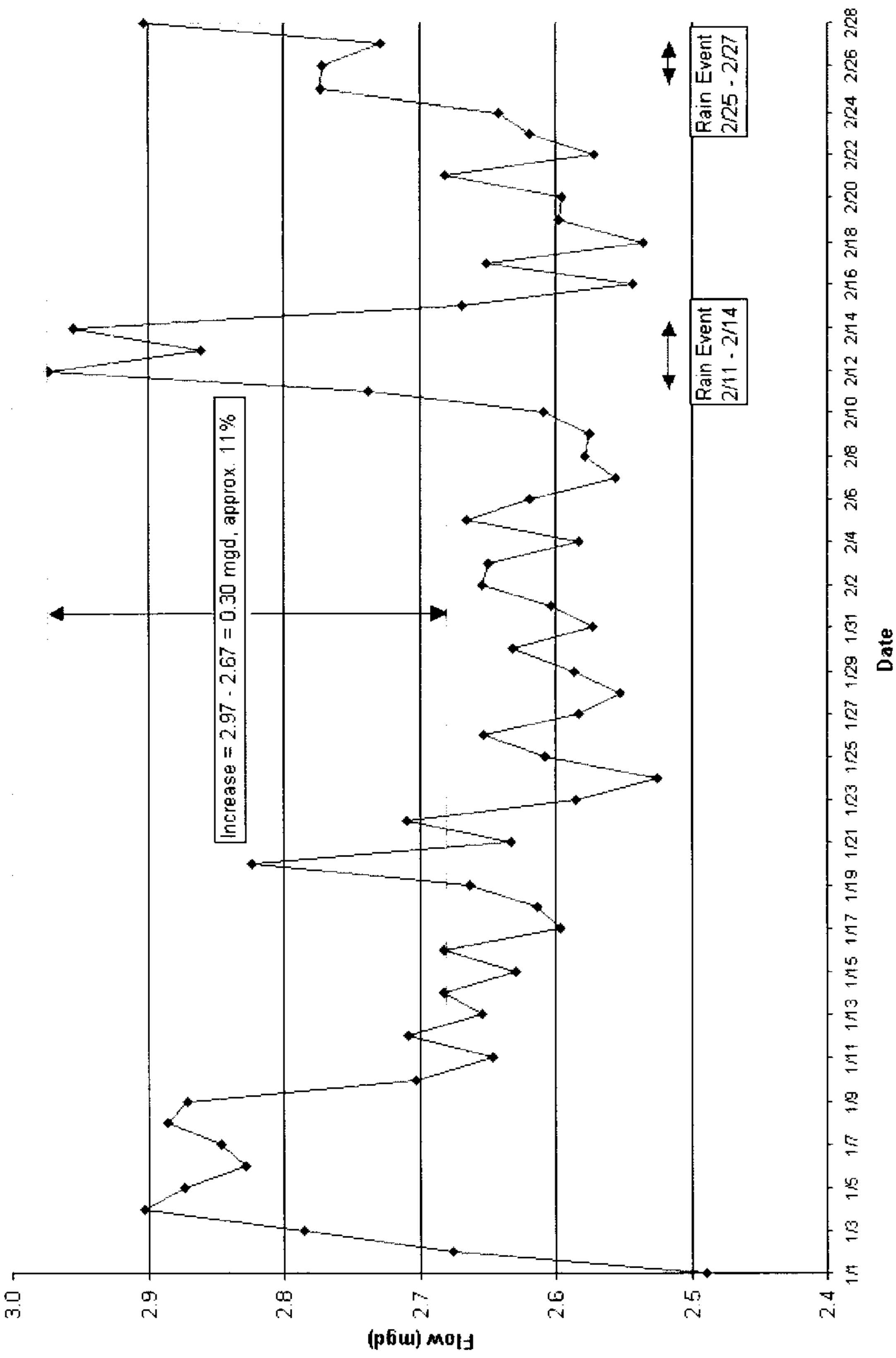


**Figure 4-5. Inflow and Infiltration Analysis – CV-3 Meter Average Flow Record**
**January 1, 2003 - February 28, 2003**

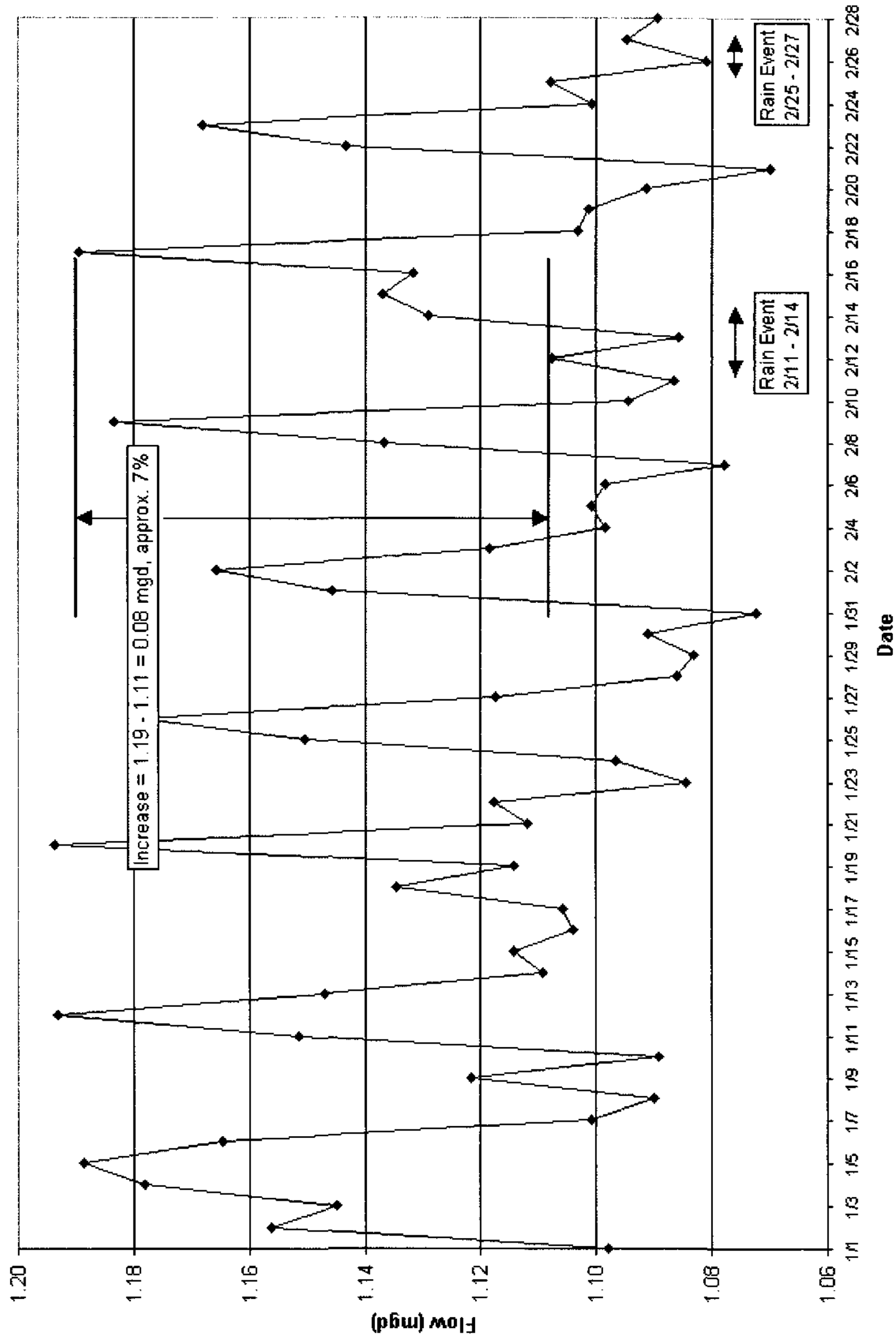


**Figure 4-6. Inflow and Infiltration Analysis – CV-7 Meter Average Flow Record January 1, 2003 - February 28, 2003**

The physical parameters of the model, including pipe diameter, slope, and roughness coefficients were based principally on review of record construction drawings. Where this data appeared to be inaccurate or unclear, field surveys were conducted.

Sewage loading projections were based on calibrated flow rates. The peak flow rates used for calibration of the Northwest and Telegraph Canyon models were selected from a 2-week period during 2003. This period included complete flow records for the Memorial Day holiday as well as two weekends, which were assumed to represent the maximum peak dry weather flow that will be experienced within the basin. Additional flow anticipated to enter the sewer system due to wet weather infiltration was assumed to be 10 percent of the dry weather peak flow, as discussed in the above section.

Since a degree of uncertainty exists in both the physical data and the sewage loading projections used as model inputs, reaches identified by model simulations as near or at capacity should be subject to additional engineering evaluation prior to improvement. Such evaluation may include field inspection, video monitoring, and flow metering.

## 4.6 HYDRAULIC MODELS

The hydraulic modeling tool used for the capacity analysis of the sanitary sewer system was XP-SWMM. The sections below describe the process of building and calibrating the models.

### North-West Sewer Model

#### *Model Extent*

The Northwest model includes the Sweetwater, G Street, Telegraph Canyon (west of Hilltop Avenue), and Main Street Sewer Basins. A majority of the collection system included within the Northwest model includes small diameter sewers that serve areas that are either fully developed or are expected to experience little additional growth. To reduce the computational effort and simplify the analysis of the model results, selected portions of the system, which serve these areas, were not included in the model.

In order to identify the pipes less than 12 inches in diameter that should be modeled, a screening process was developed. The first step in the process included identification of the approximate minimum sewer pipe slope within the City system. Next, the number of EDU's that could be served by a pipe with that slope was computed for 6-, 8-, and 10-inch diameter pipe sizes. By counting upstream EDU's, each pipe in the system was systematically analyzed for its ability to pass the required flow at less than 50 percent full. If a pipe could not pass the required flow at half full, additional steady-state hydraulic analysis of the reach was made using the actual pipe slope. Those pipes in which the peak flow depth exceeded half full were included in the hydraulic model, as well as all pipes 12-inches and larger. The model network is shown in Exhibit 1.

### Model Loading

Wastewater loading was estimated for tributary basins that drain to selected manholes in the collection system. Exhibit 1 shows the tributary basins included in the model. The model simulates wastewater flows within each tributary basin by adding together diurnal flows generated by four separate land use classifications including residential, commercial, industrial, and institutional. Residential flows were based on a unit generation rate per dwelling unit and non-residential flows were estimated by applying a unit generation rate per acre. The unit generation rates were determined through calibration of the model against metered flow records as discussed in the following section. Dwelling unit counts and non-residential acreages for each tributary basin were determined through application of GIS tools that intersect the tributary basin boundaries with the City's parcel database, effectively extracting parcel information to a pre-processing program that compiles the total dwelling units and acreages per land use classification. Land use data used as model input and land use data for City areas not included in the models are provided in Appendix D.

The preprocessing program calculates average wastewater (gallons per day) generated by each land use for each tributary basin. These average flow rates are then transposed into time-varying hydrographs by application of dimensionless diurnal curves and the resulting hydrographs for each land use classification were combined to produce a single inflow hydrograph that is input by the model at the tributary manholes.

Both existing and ultimate buildout models of the basins were developed. City buildout assumed 100 percent development of existing vacant parcels in accordance with current zoning and land use designations.

### Model Calibration

Following development of the input data sets, the model was calibrated to dry-weather meter data recorded between May 17 and June 16, 2003. Simulated flow hydrographs at each meter location were compared with recorded depth and discharge measurements. The purpose of the comparison was to allow for refinement of estimated model parameters so that the simulated flow conditions reasonably approximated the measured flow conditions. These parameters generally include unit generation rates, diurnal curve patterns, and peak to average flow ratios (peaking factors). Results of the calibration are best presented graphically, and are shown in Figures 4-7 through 4-16.

Calibrated weekend generation rates for residential development varied within the model, with a higher generation rate of 230 gpd per Single Family dwelling unit applicable to tributary areas within the Sweetwater and G Street Sewer Basins and a unit generation rate of 195 gpd per Single Family dwelling for areas in the Telegraph Canyon and Main Street Sewer Basins. Calibrated weekend generation rates for industrial and commercial development was 1,400 gpd per acre and 800 gpd per acre, respectively. Since the models were representative of weekend loading conditions and were calibrated to weekend flow records, institutional land uses (which include principally school uses) were assumed to contribute no flow to the system. Table 4-1 shows the calibrated unit generation rates.

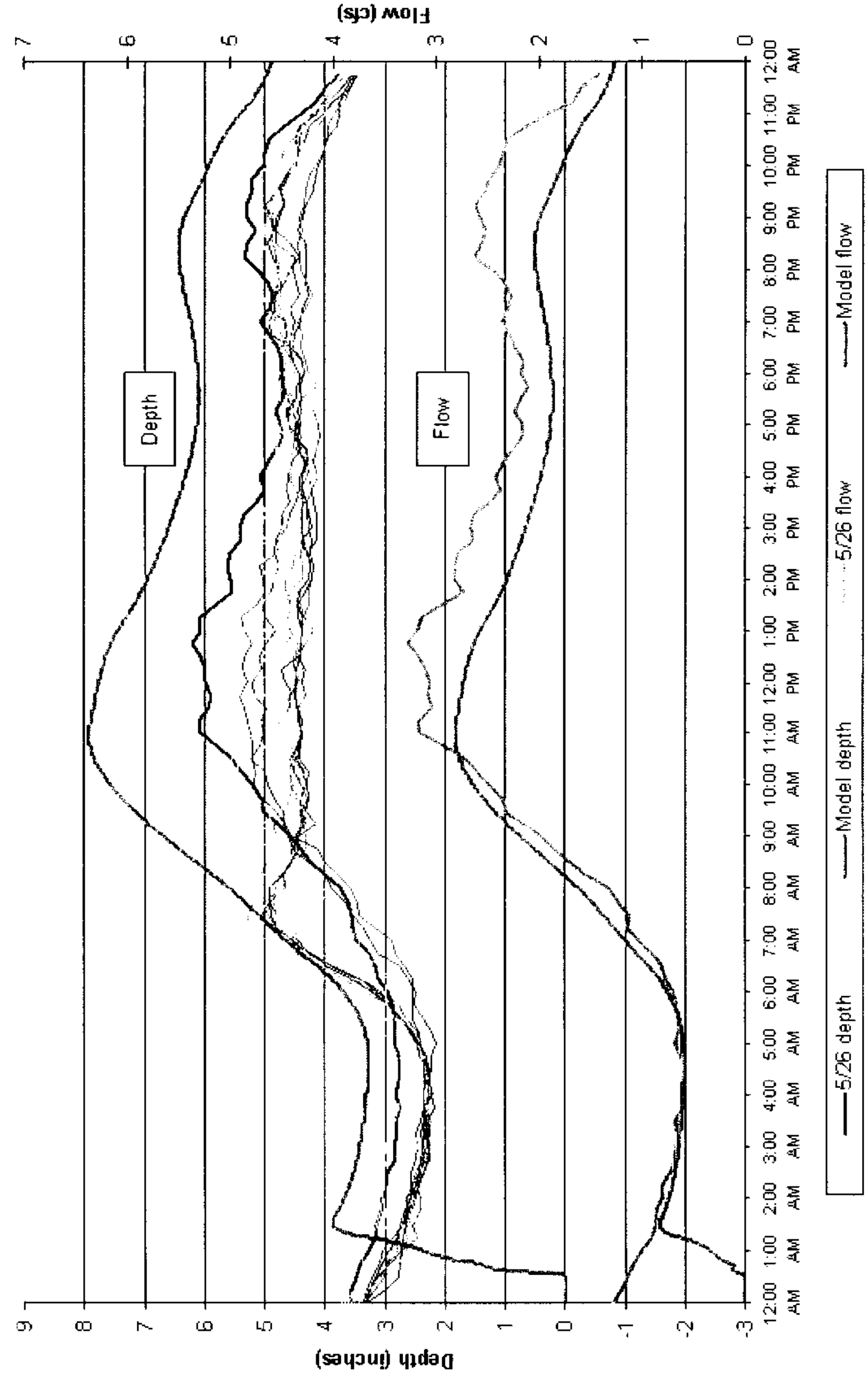


**Figure 4-7. Manhole 5079 – Main Street & Industrial Avenue
12-inch Diameter – North West Model**

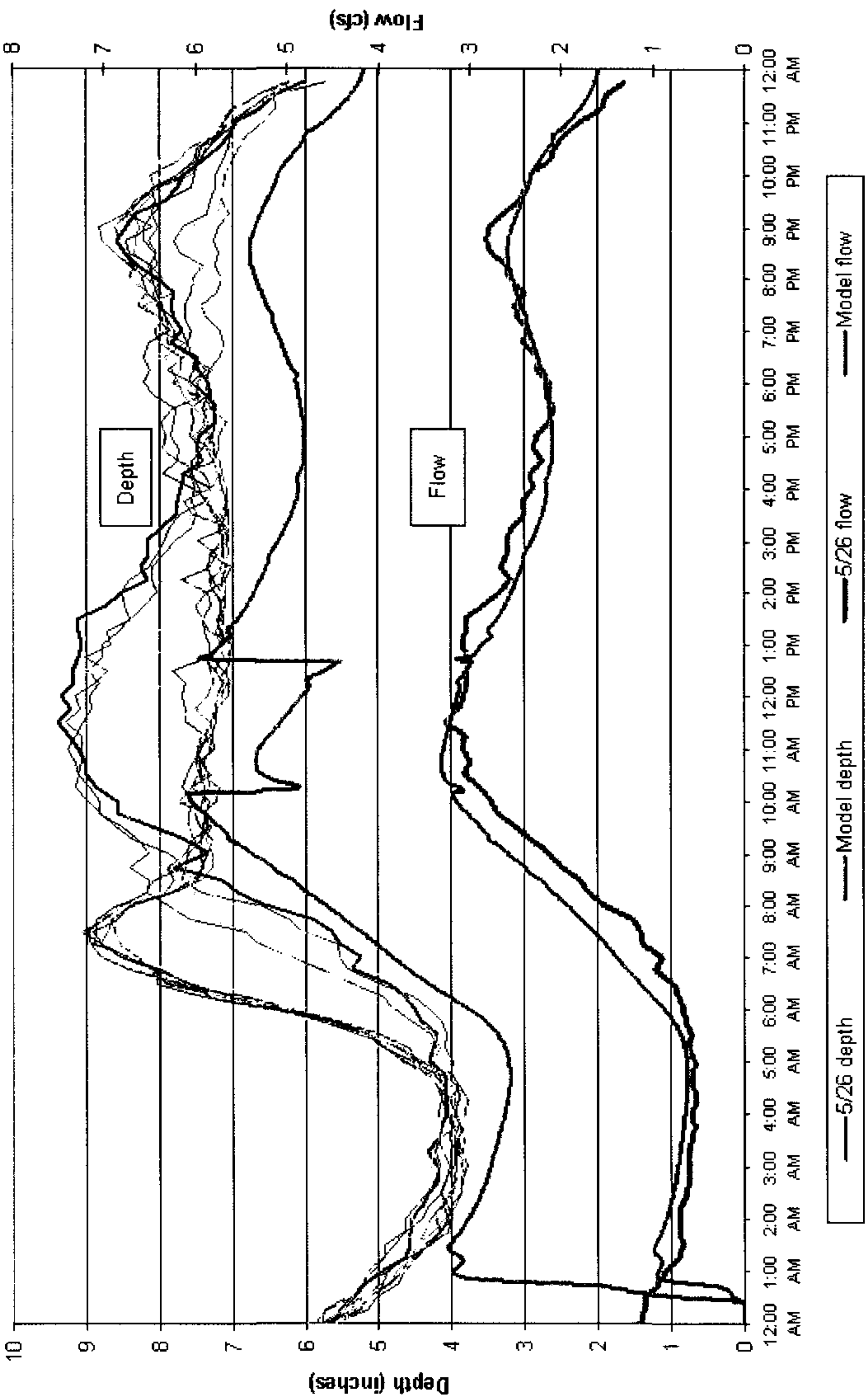


**Figure 4-8. Manhole 5122 – Main Street, East of Fourth Avenue**
**15-inch Diameter – North West Model**

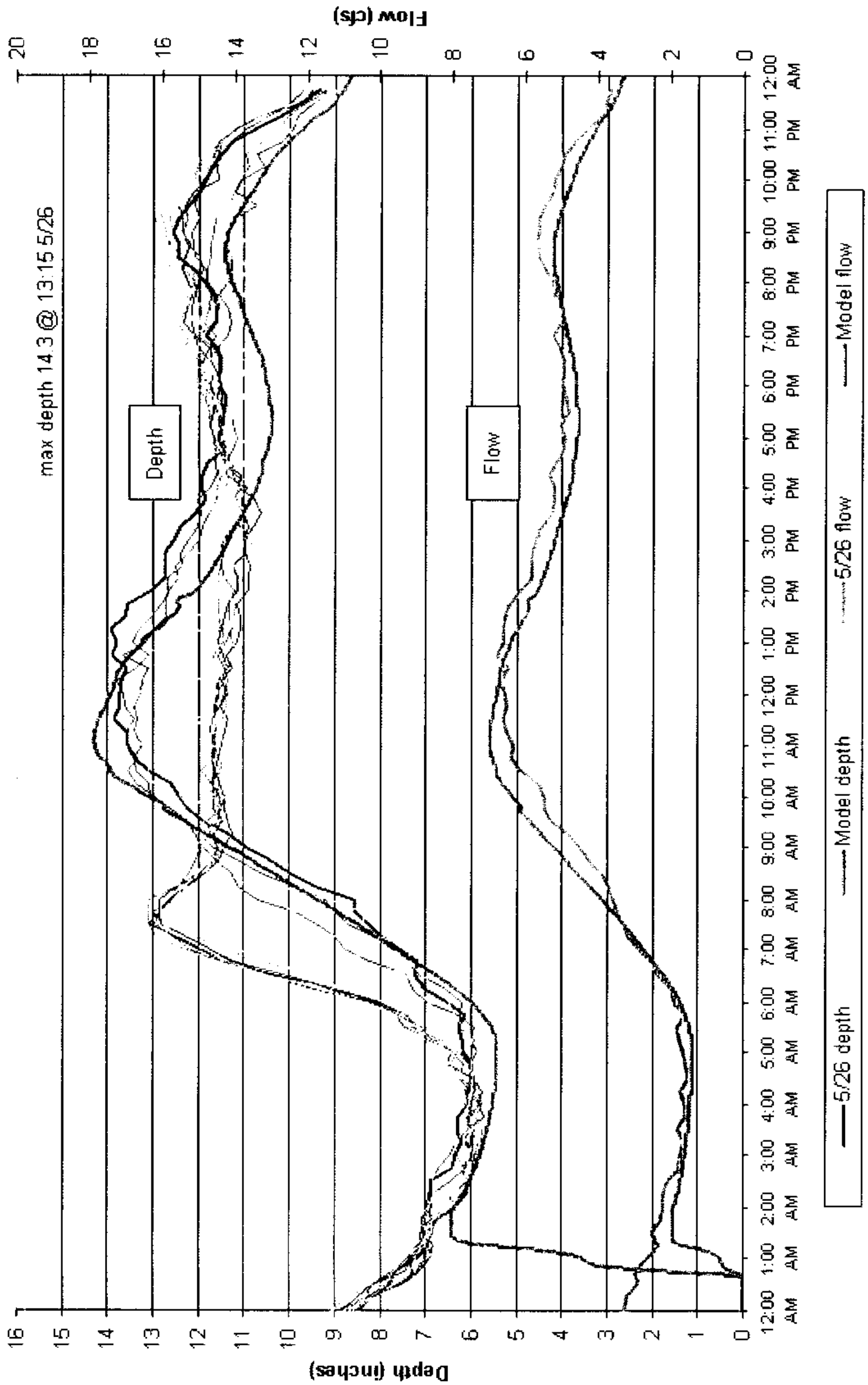


**Figure 4-9. Manhole 5144 – Meter CV1 - Hollister Avenue, South of Main Street 18-inch Diameter – North West Model**

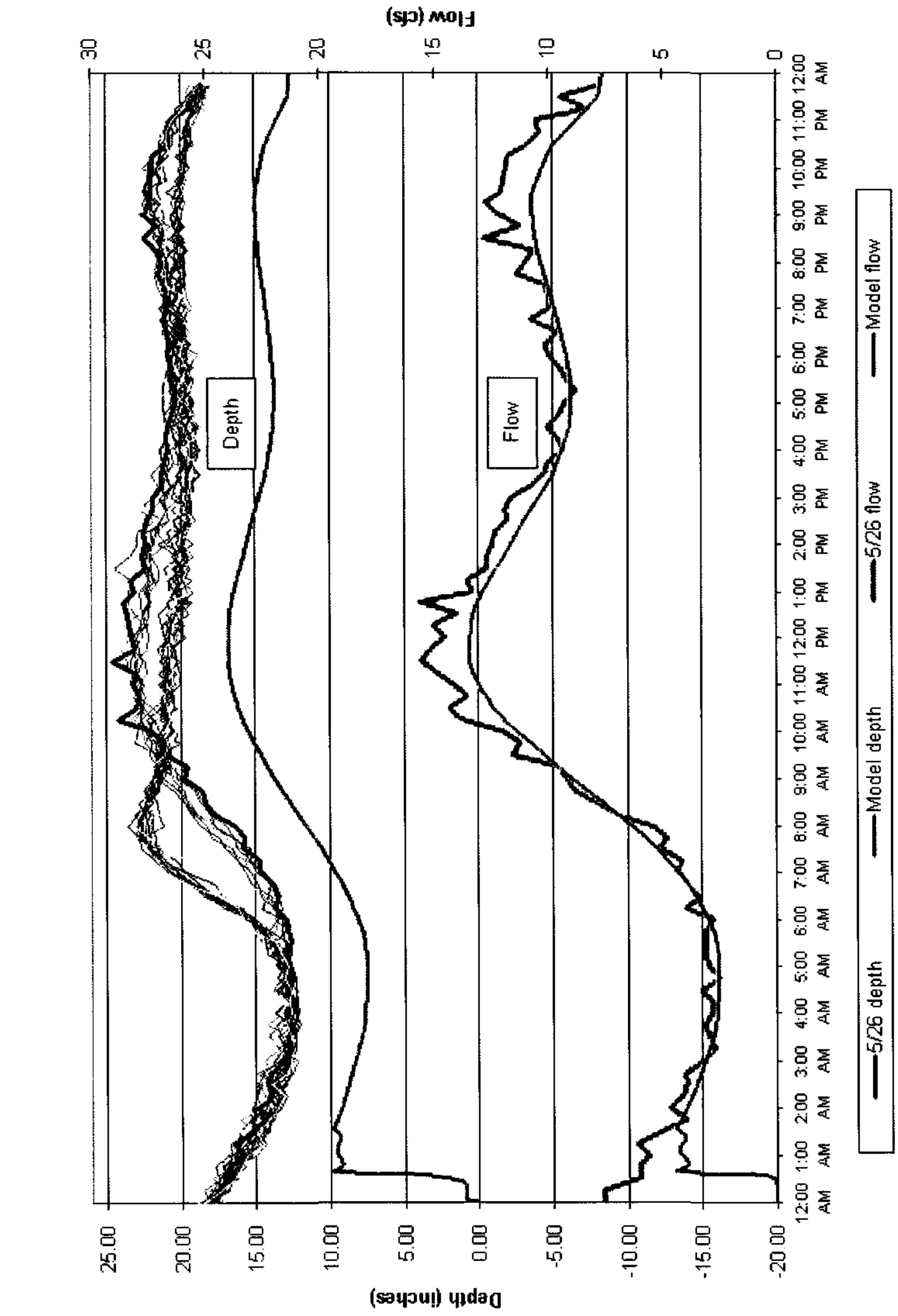


**Figure 4-10. Manhole 4223 – Meter CV2 – J Street, West of Fourth Avenue 18-inch Diameter – North West Model**

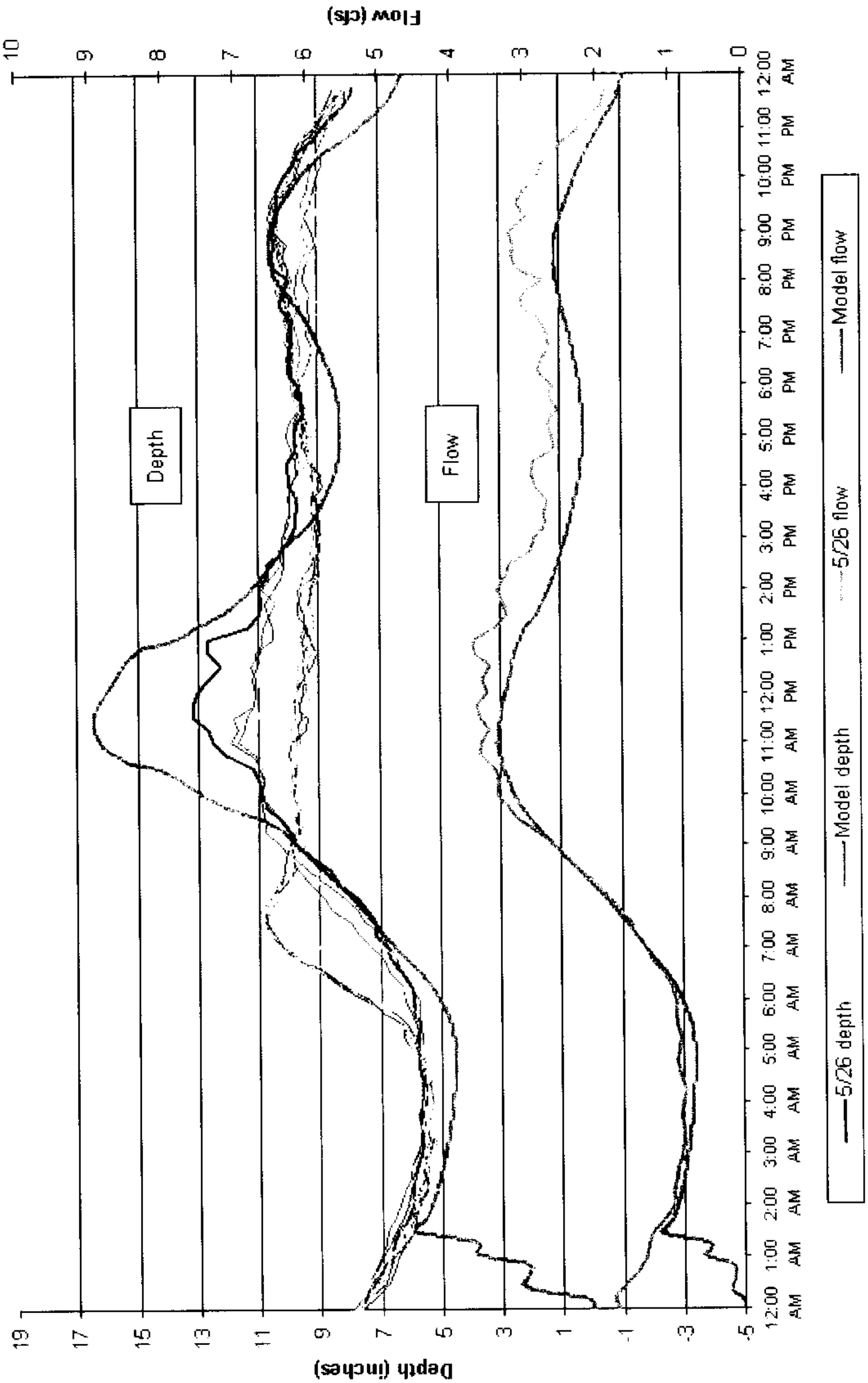


**Figure 4-11. Manhole 4243 – Colorado Avenue, South of J Street 15-inch Diameter – North West Model**

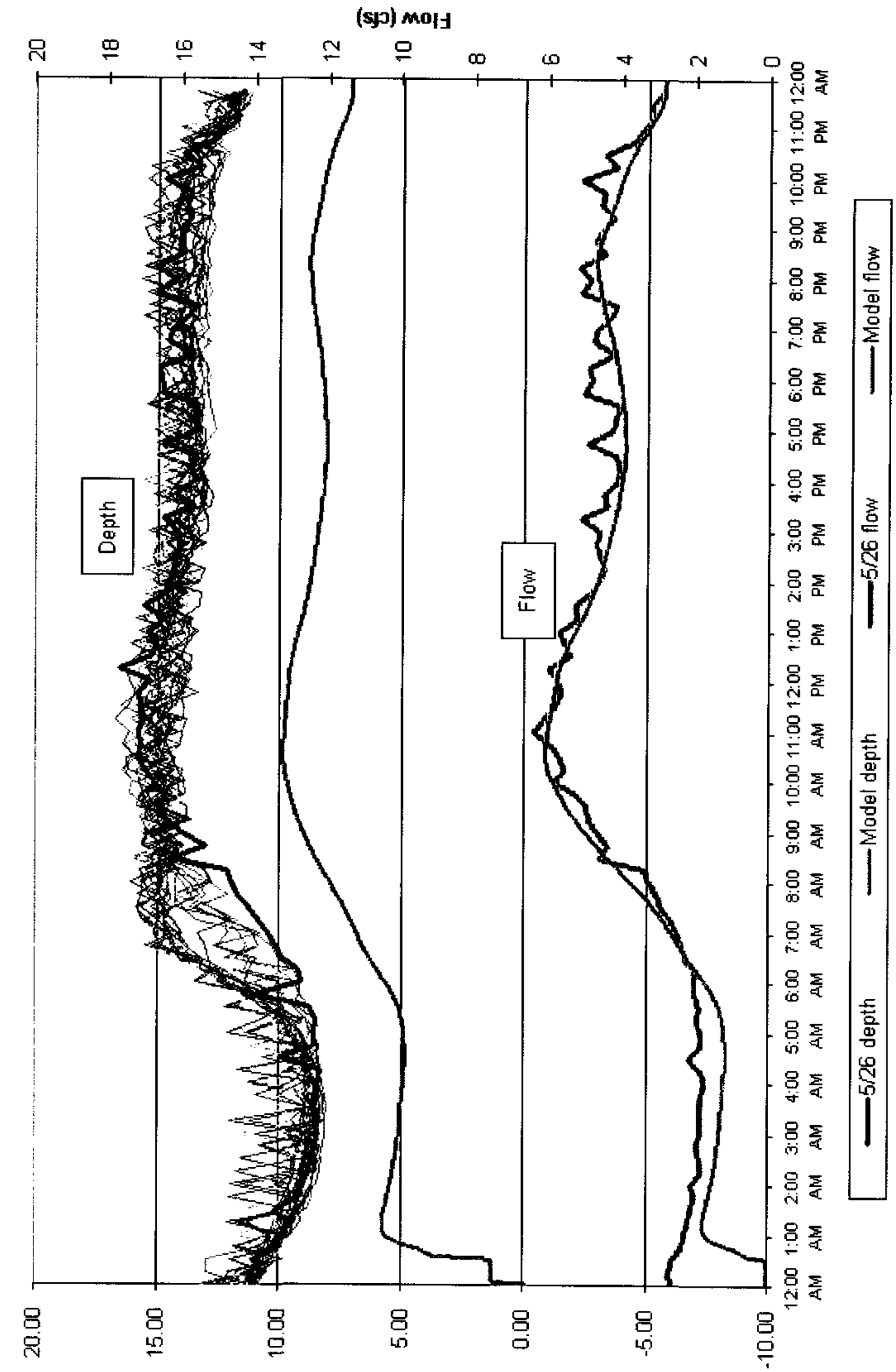


**Figure 4-12. Manhole 3170 – Meter CV3 – G Street, West of Bay Boulevard 24-inch Diameter – North West Model**

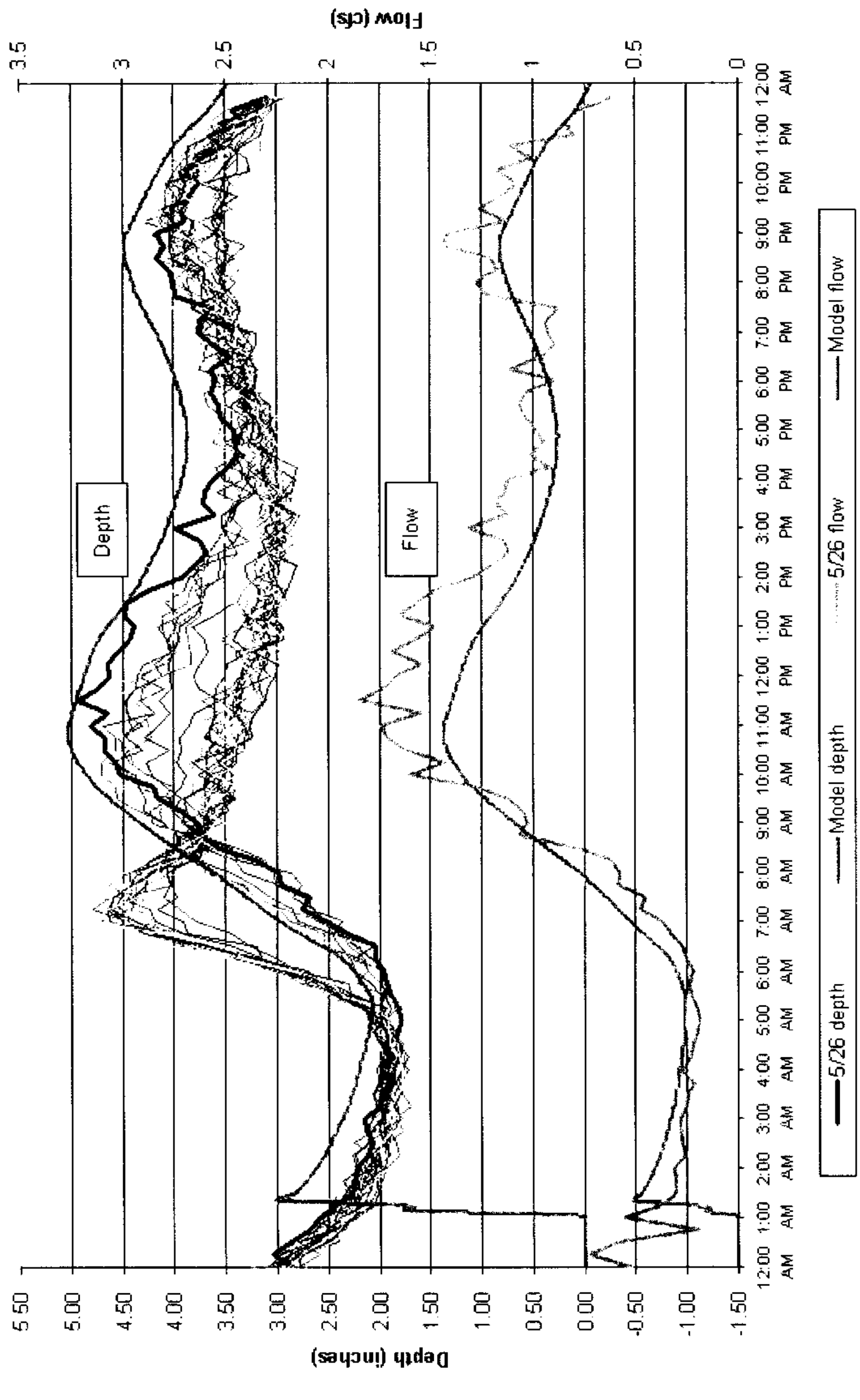


**Figure 4-13. Manhole 49 – Meter CV10 – Acacia Avenue and Golfglen Road 12-inch Diameter – North West Model**

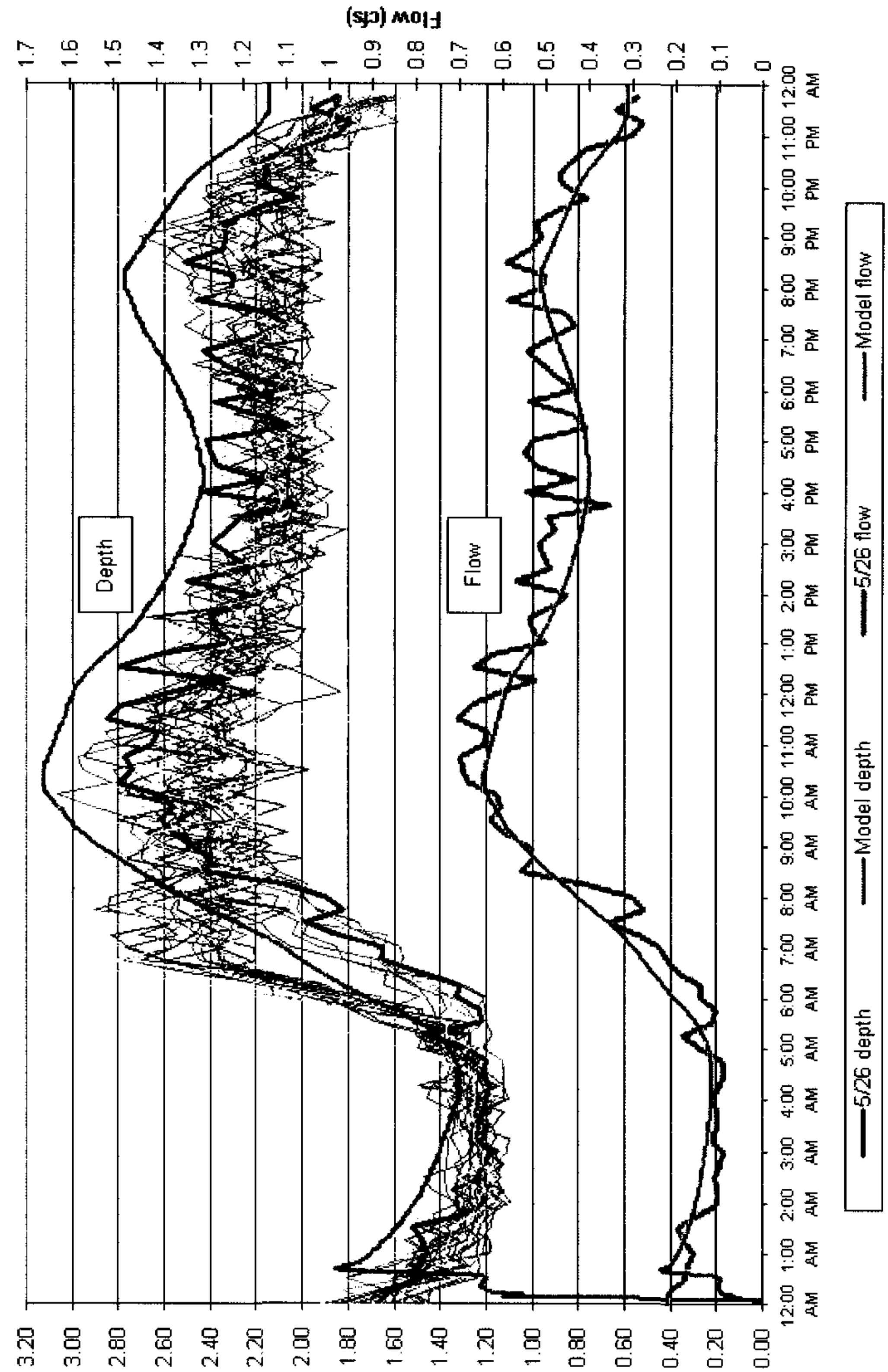


**Figure 4-14. Manhole 175 – Meter CV11 – Otay Lakes Road, South of Bonita Road 8-inch Diameter – North West Model**

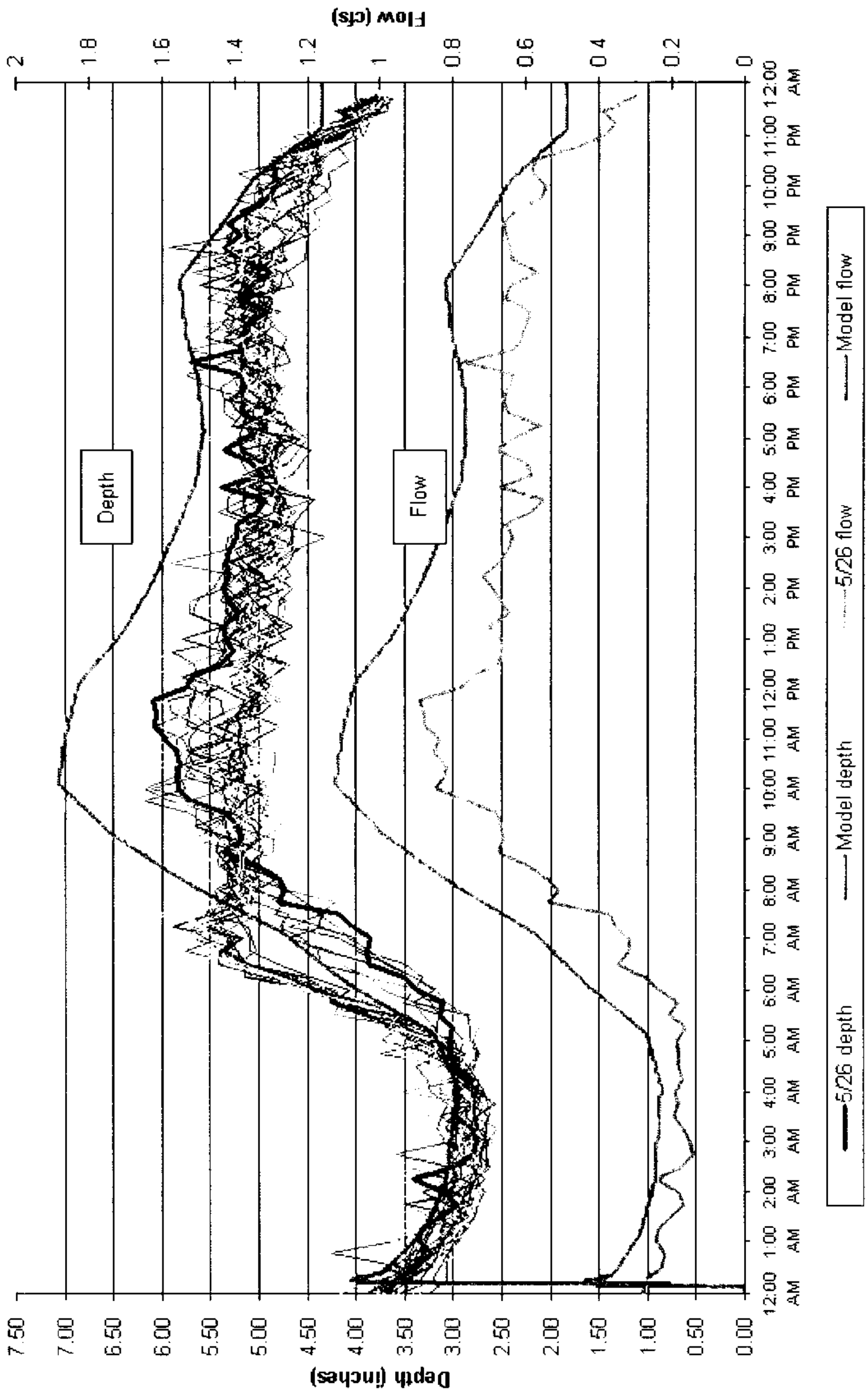


**Figure 4-15. Manhole 914 – Meter CV9 – Fifth Avenue, North of C Street**
**12-inch Diameter – North West Model**

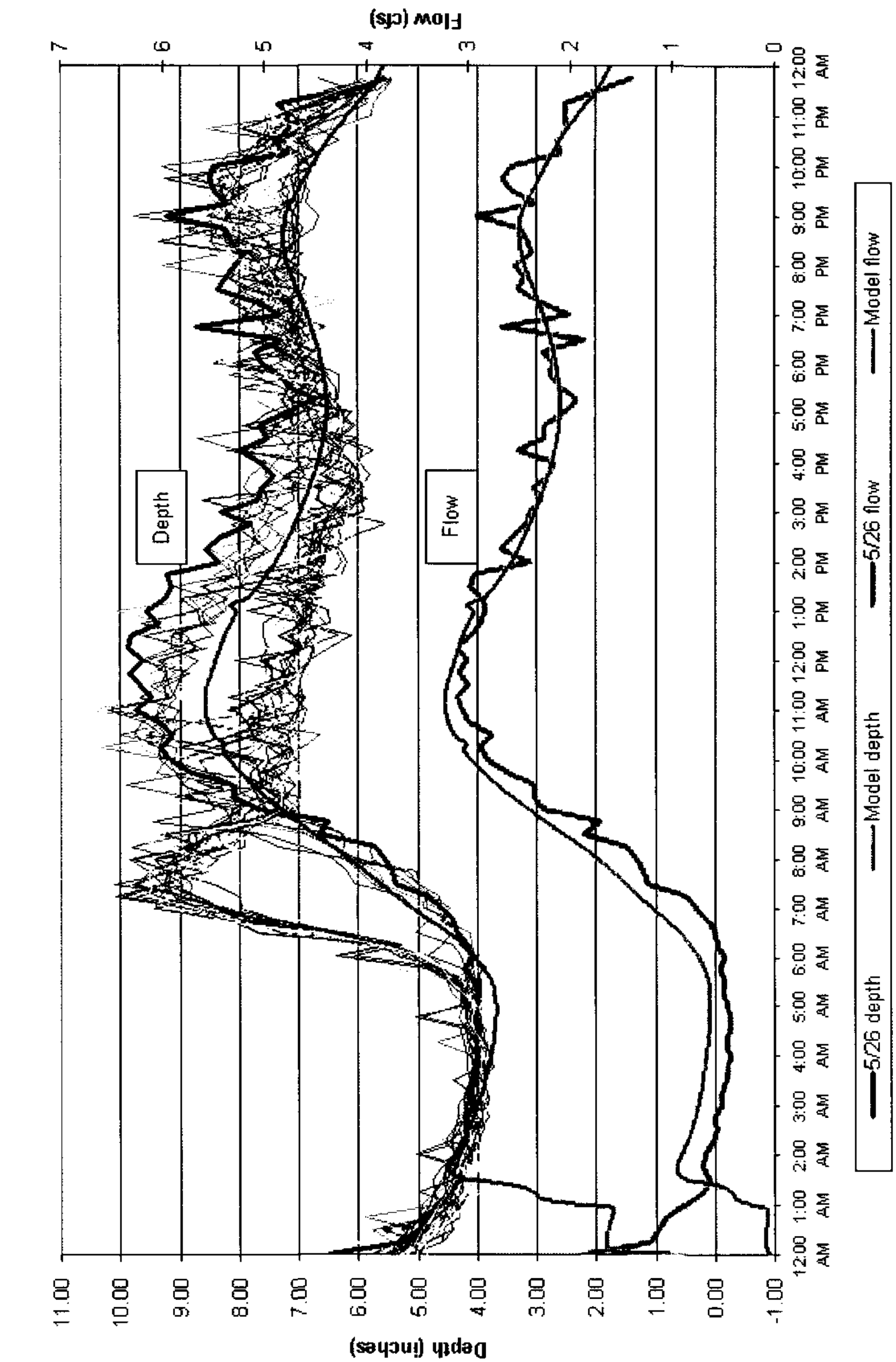


**Figure 4-16. Manhole 1074 – Meter CV7 – Plaza Bonita Road, North of Bonita Road 18-inch Diameter – North West Model**

**Table 4-1**
**North-West Model Calibrated Weekend Unit Generation Rates**

| Land Use Classification | Unit Generation Rate |
|---|---|
| Single Family Residential | 230 gpd/DU (Sweetwater and G Street)<br>195 gpd/DU (Telegraph Canyon West and Main St.) |
| Multi-Family Residential | 169 gpd/DU (Sweetwater and G Street)<br>146 gpd/DU (Telegraph Canyon West and Main St.) |
| Industrial | 1,400 gpd/ac |
| Commercial | 800 gpd/ac |
| Institutional | Not Applicable |

### *Field Verification*

Preliminary verification of the model was performed through field inspections conducted on December 12, 2003. Three groups of manholes indicated by the model to be flowing near full or surcharging were visually inspected between 8:30 am and 9:00 am, which is near the peak of the weekday diurnal pattern. Specific sewers inspected were located in Center Street east of 4th Avenue, adjacent to the Police Station; Colorado Street between K and J Streets; and Moss Street between Jefferson and Oaklawn Avenues. The Center Street sewer (12-inch diameter) was observed as surcharged, Colorado Street sewer (15-inch diameter) was flowing approximately three-quarters full, and the Moss Street sewer (8-inch diameter) was flowing approximately one-half full.

The observed flow depths were expected to be somewhat less than modeled conditions because the model was calibrated to a high flow, weekend diurnal pattern. Therefore, the model's ability to reasonably predict existing condition flows was supported by the field observations.

## Telegraph Canyon East Sewer Model

### *Model Extent*

The Telegraph Canyon East model includes the Telegraph Canyon Trunk Sewer from just south of J Street in Hilltop Drive (model Manhole 35) to Lane Avenue in Otay Lakes Road (model Manhole 120). The sewer ranges in diameter from 12 to 21 inches. The model network is shown in Exhibit 2.

### *Model Loading*

Wastewater loading was estimated for tributary basins that drain to selected manholes in the collection system. Exhibit 2 shows the tributary basins included in the model. The model simulated wastewater flows within each tributary basin by applying a single diurnal flow pattern to the average wastewater flow. The average flow was estimated by multiplying the number of tributary Equivalent Dwelling Units (EDU) by a unit generation rate (gallons per day per EDU).

The diurnal flow pattern was based on meter data collected at CV-10, which was assumed to be representative of generation patterns in the Eastern Telegraph Canyon Basin. EDUs were estimated by multiplying parcel counts by equivalency factors based on the City's subdivision manual. The factors used are given in Table 4-2. The unit generation rate for the model was determined through calibration against metered flow records as discussed in the following section.

Both existing and ultimate buildout models of the basin were developed. City buildout assumed 100 percent development of existing vacant parcels in accordance with current zoning and land use designations.

**Table 4-2**
**Telegraph Canyon Sewer Model**
**EDU Equivalent Factors**

| Land Use Classification | EDU Equivalency(1) |
|---|---|
| Single-Family Residential | 1.0 |
| Multi-Family Residential | 0.75 |
| Commercial / Industrial | 9.4 |
| Elementary School | 34.0 |
| Medical Offices | 20.5 |

(1) Equivalency based on Subdivision Manual generation rates:
SF Residential – 265 gpd/DU
Commercial – 2,500 gpd/Ac
Elementary School – 600 students at 15 gpd per student
Medical Offices – 5,431 gpd/ac (based on data from Kaiser Permanente)

### *Model Calibration*

Following development of the input data sets, the model was calibrated to dry-weather meter data recorded between May 23 and June 6, 2003 at model manholes 35 and 75. Simulated flow hydrographs at each meter location were compared with recorded depth and discharge measurements. The purpose of the comparison was to allow for refinement of estimated model parameters so that the simulated flow conditions reasonably approximated the measured flow conditions. Results of the calibration are shown in Figures 4-17 and 4-18.

The calibrated unit generation rate was 160 gpd per EDU based the May and June 2003 flow records. Based on comparison with the calibrated generation rates developed in the Northwest model, the unit rate for residential dwellings appears to be relatively low and may not represent the actual generation rates for residential development within the model basin. However, the model EDU conversion factors result in unit generation rates for non-residential land uses that are significantly higher than the Northwest model rates, effectively resulting in an average generation rate that accurately models the basin-wide wastewater generation. Since the basin is nearly built-out, this EDU approach was deemed appropriate for analysis of the trunk sewer.

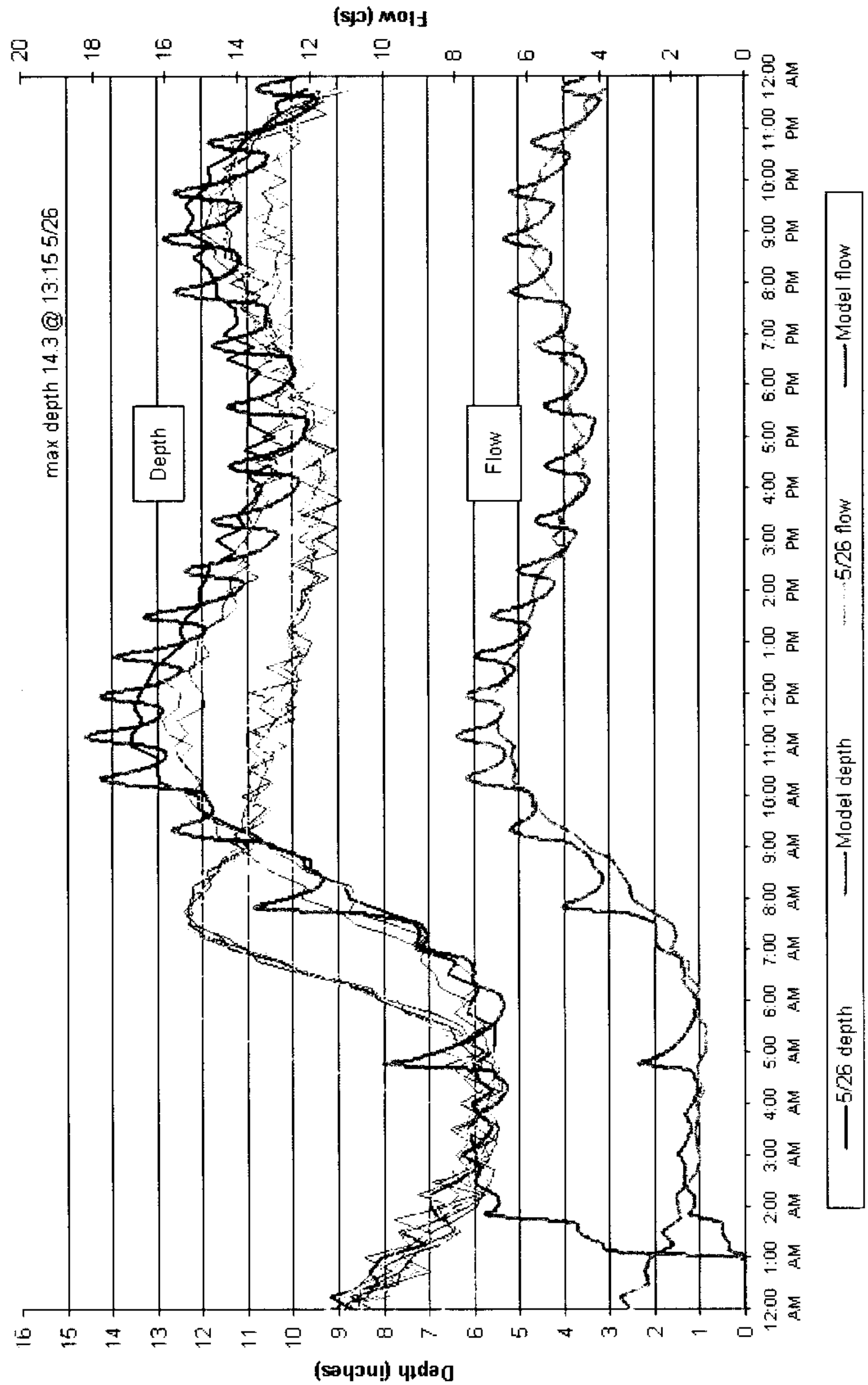


**Figure 4-17. Manhole 35 – Hilltop Drive, South of J Street 21-inch Diameter – Telegraph East Model**

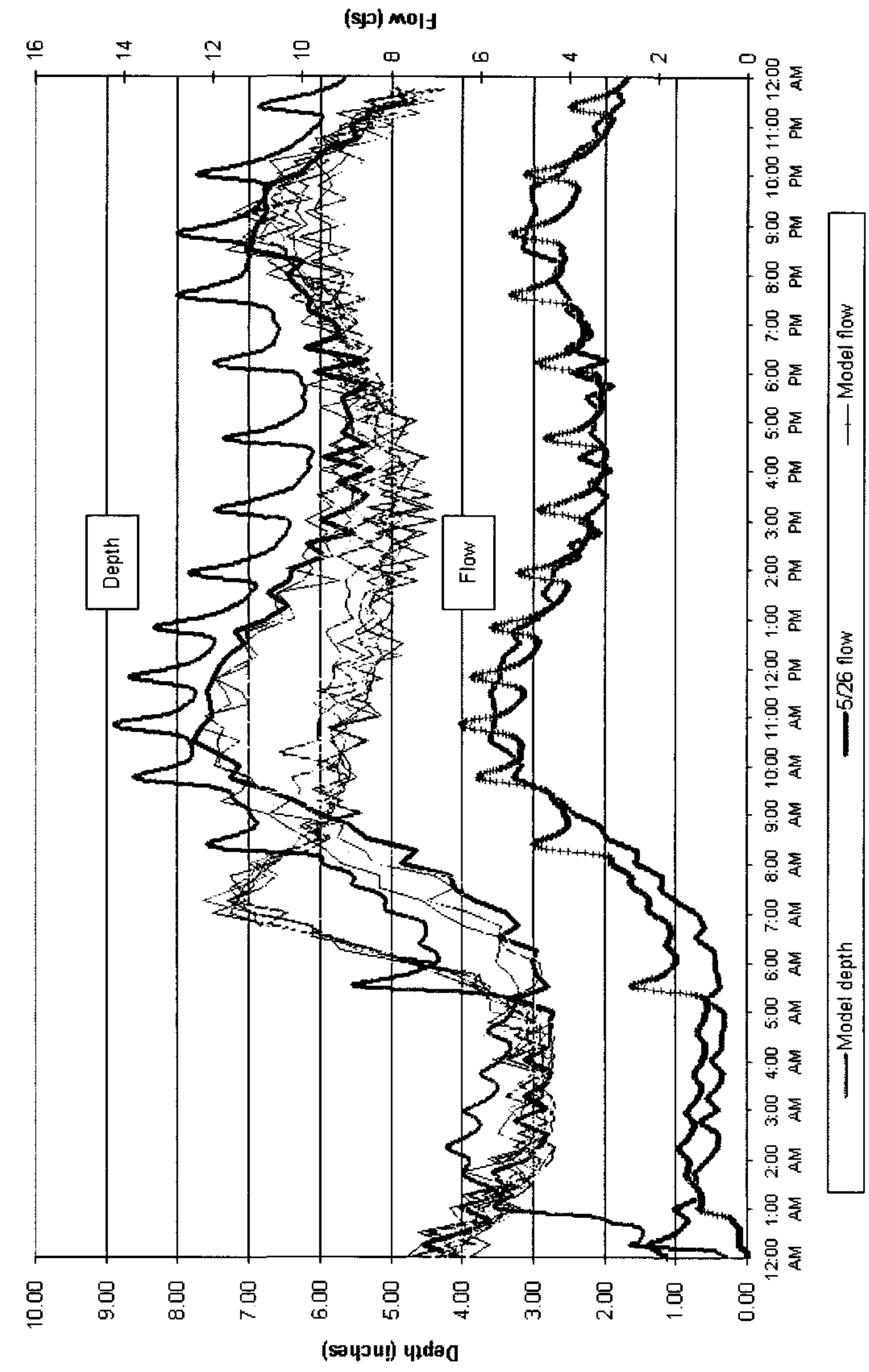


**Figure 4-18. Manhole 75 – Telegraph Canyon Road, West of Paseo Ladera 21-inch Diameter – Telegraph East Model**

## Poggi Canyon Sewer Model

### *Model Extent*

The Poggi Canyon model includes the Poggi Canyon Interceptor from just east of EastLake Parkway (model Manhole P660) to the connection to the Salt Creek Interceptor in Main Street (model Manhole P102) west of Melrose Avenue. The Interceptor ranges in diameter from 18 to 21 inches. Also included in the model is the Date-Faivre Trunk Sewer from Palm Avenue and Valley Road (model Manhole D285) to the connection to the South Metro Interceptor (model Manhole D100) west of Interstate 5. The trunk sewer ranges in size from 15- to 30-inch diameter and receives flows from the Date-Faivre sewer basin. The modeled network is shown in Exhibit 3.

### *Model Loading*

Wastewater loading was estimated for tributary basins that drain to selected manholes in the collection system. Exhibit 3 shows the tributary basins included in the model. The model simulated wastewater flows within each tributary basin by adding together diurnal flows generated by two land use classifications – residential and non-residential development. Residential flows were based on a unit generation rate per dwelling unit and non-residential flows were estimated by applying a unit generation rate per acre. The unit generation rates were determined through calibration of the model against metered flow records as discussed in the following section. Dwelling unit counts and non-residential acreages for each tributary basin were determined through application of GIS tools that intersect the tributary basin boundaries with the City's parcel database and, for new or planned development areas not in the GIS database, tentative maps or other planning documents. Land use data used as model input is included in Appendix D.

The preprocessing program calculated average wastewater (gallons per day) generated by each land use for each tributary basin. These average flow rates are then transposed into time-varying hydrographs by application of dimensionless diurnal curves and the resulting hydrographs for each land use classification were combined to produce a single inflow hydrograph that is input by the model at the tributary manholes.

### *Model Calibration*

The Poggi Canyon model was initially developed and calibrated as part of the *Poggi Canyon Sewer Basin Plan Update and Pumped Flow Analysis* (May 2002, PBS&J). Since recent development patterns have remained consistent with the land use mixture in the basin at the time of model calibration, the model parameters established in the Basin Update study were used in this analysis.

The Basin Update calibration was achieved by adjusting model parameters such that simulated flow depth at selected manholes reasonably matched meter records collected over several periods during September and November 2001, including the Thanksgiving holiday, and January 2002. Results of the calibration are shown in Figures 4-19 through 4-21.

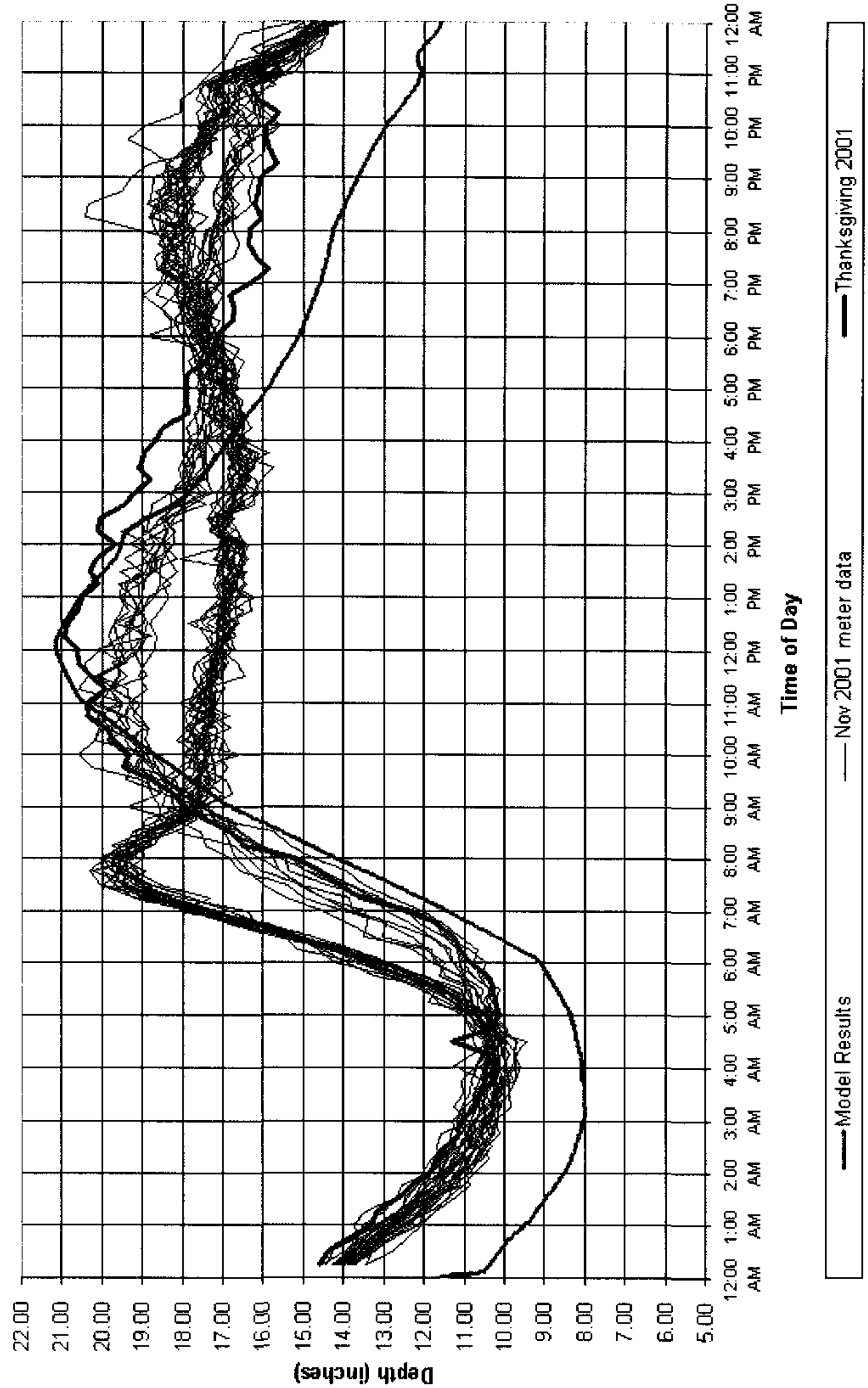


**Figure 4-19. Meter CV1 – Hollister Street and Louret Avenue 27-inch Diameter – Poggi Canyon Model**

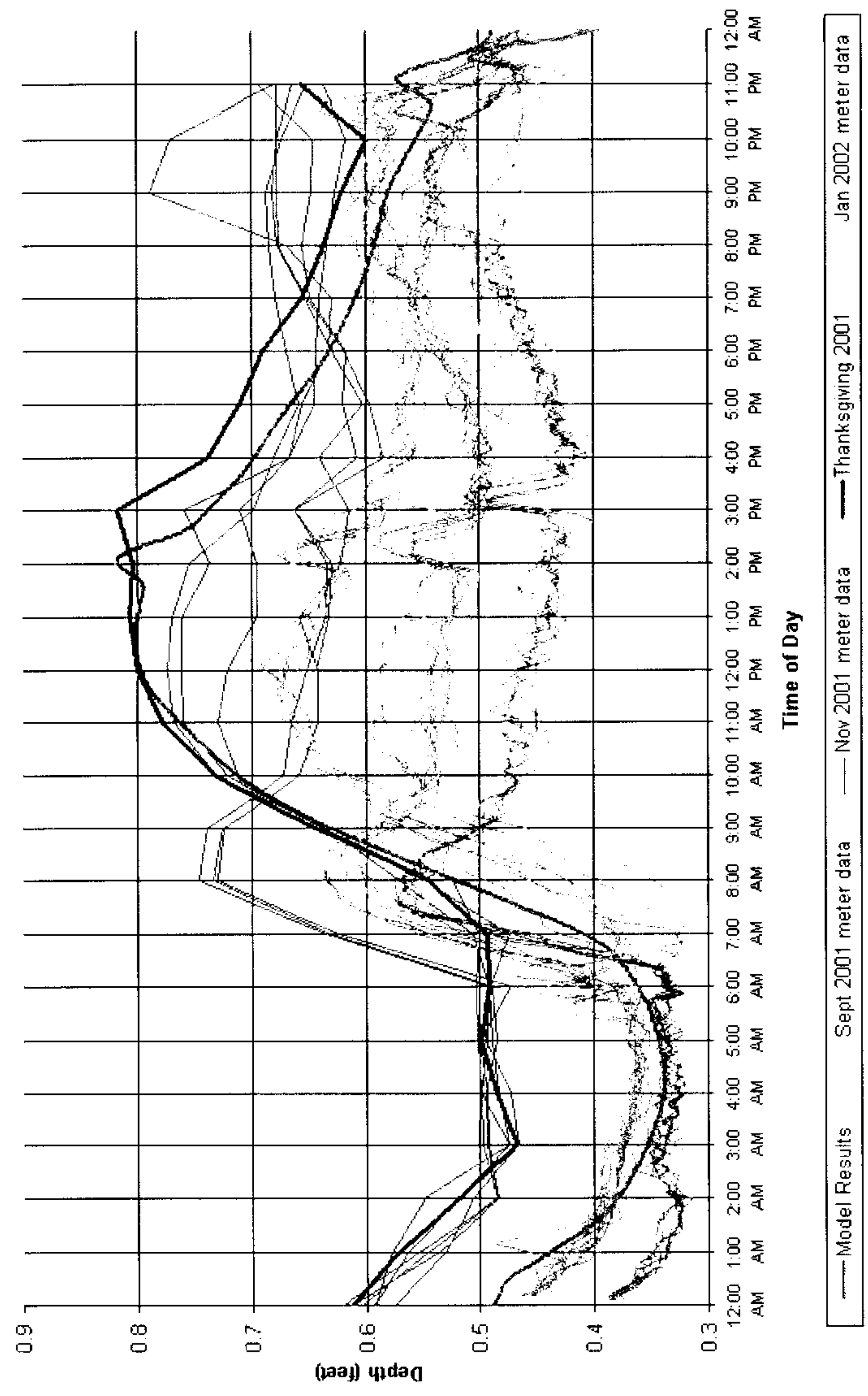


**Figure 4-20. Manhole 6836 – Melrose Avenue, South of Talus Street 18-inch Diameter – Poggi Canyon Model**

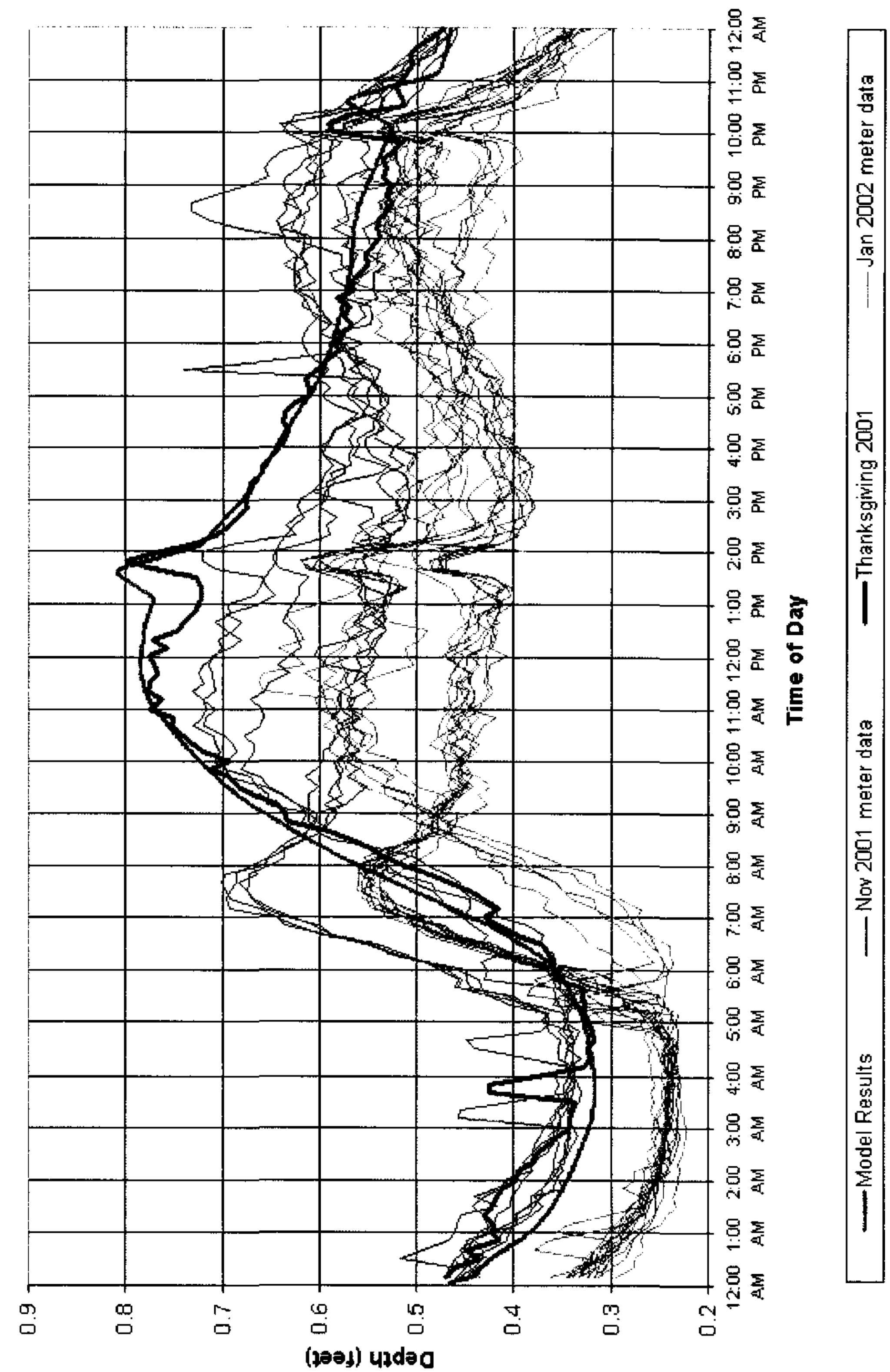


**Figure 4-21. Manhole 5201 – West of Valley Avenue before Mace Street 15-inch Diameter – Poggi Canyon Model**

The calibrated unit generation rates were 215 gpd per single-family residential dwelling unit (DU), 161 gpd per multi-family residential DU, and 1,500 gpd per non-residential acre.

### Salt Creek Sewer Model

#### *Model Extent*

The Salt Creek model includes the Salt Creek Interceptor from Proctor Valley Road (model Manhole 450) to the connection to the South Metro Interceptor (model Manhole 105) west of Interstate 5. The Salt Creek Interceptor ranges in diameter from 15 to 42 inches. The model also includes a 12-inch diameter sewer from the Olympic Training Center (model Manhole 384) to a connection to the Salt Creek Interceptor (model Manhole 348). The modeled network is shown in Exhibit 4.

#### *Model Loading*

Wastewater loading was estimated for tributary basins that drain to selected manholes in the collection system. Exhibit 4 shows the tributary basins included in the model. The model simulated wastewater flows within each tributary basin by adding together diurnal flows generated by two land use classifications – residential dwelling units and non-residential development. Residential flows were based on a unit generation rate per dwelling unit and non-residential flows were estimated by applying a unit generation rate per acre. Since land use patterns are similar to those in the Poggi Basin, unit generation rates from that model were applied to the Salt Creek Model. Projected dwelling unit counts and non-residential acreages at City buildout for each tributary basin were taken from the City's Traffic Analysis Zone (TAZ) model. GIS tools were used to intersect the tributary basins with the traffic zones and extract projected parcel information. Land use data used as model input is included in Appendix D.

The preprocessing program calculated average wastewater (gallons per day) generated by each land use for each tributary basin. These average flow rates are then transposed into time-varying hydrographs by application of dimensionless diurnal curves and the resulting hydrographs for each land use classification combined to produce a single inflow hydrograph that is input by the model at the tributary manholes.

## 4.7 CAPACITY ANALYSIS

Once model calibration and the existing and future condition runs were completed, the results of the model are analyzed for reasonableness and necessary facility improvements identified. Existing condition analysis was performed for basins within the Northwest model to identify any immediate capacity constraints within the collection systems serving these basins. Flow conditions under ultimate basin buildout conditions were simulated with each of the four models with the objective of evaluating the capacity of the existing collection system to convey projected buildout flows.

Pipe reaches in which simulated wet-weather flows exceeded a flow depth to pipe diameter ratio of 0.85 were identified as potential improvement reaches. The identified capacity limitations were analyzed for reasonableness by verifying that the lack of capacity reported by the model was a function of a downstream pipe size not extending far enough upstream and/or a pipe slope flatter than adjacent segments. Improvements required to provide adequate capacity for projected flows were then determined through an iterative modeling process. The process consisted of simulating flow conditions after increasing the diameter of downstream portions of the identified reaches. In subsequent iterations additional lengths of pipe were increased in diameter until the projected peak flow could be conveyed through the reach without exceeding a specified design flow depth. When sizing pipes for ultimate conditions, the size of the replacement pipe was increased such that peak d/D ratios within the improved reach were less than 0.75 for pipes 12-inches and larger and 0.50 for pipes smaller then 12-inches.

No constrained reaches were identified in the Telegraph Canyon East, Poggi Canyon, or Salt Creek Models. Several reaches in the Northwest model were identified as over-capacity under both existing and ultimate basin buildout. Simulated buildout flow conditions for each model are presented in Appendix E.

The Northwest model simulations indicated that sewer reaches at four locations may be overcapacity under existing, peak wet-weather conditions. No additional overcapacity reaches were identified in the buildout wet weather simulations. Simulated flow conditions in these reaches are presented in Table 4-3. Locations of the reaches are shown in Figure 4-22. Note that the City has proposed to alleviate the capacity constrains of the Main Street Trunk Sewer by diverting flows generated upstream of the constrained reaches to the Salt Creek Interceptor. Consequently, based on City calculations, no reaches of the Main Street Trunk Sewer will require improvement, beyond the construction of a diversion structure.

Prior to construction of improvements, it is recommended that the City conduct detailed engineering investigations of the identified reaches that may include field inspections, flow metering during peak flow periods (such as holidays) and under wet-weather conditions, and video inspection.

In summary, the capacity evaluation illustrated that the City has a very limited extent of capacity-constrained sewers within the collection system, a testament to judicious facility planning as the older trunk sewers located in the western portions of the City appear to generally be of sufficient diameter to convey projected flows from the extensive planned development in eastern Chula Vista. Newer mains located east of I-805, which typically have been installed through development fees, showed no capacity constraints through buildout of the City's General Plan. Impacts due to proposed changes to the City's General Plan were additionally analyzed and are presented in Chapter 5.

## Table 4-3
## Simulation Results – Recommended Improvement Reaches

| U/S Node | D/S Node | Existing Diameter (ft) | Length (ft) | Slope (%) | Max Depth (ft) | Max Q (cfs) | d/D | Max Surcharge: Time (hr) | Max Surcharge: Depth above crown (ft) | Max Surcharge: Freeboard to MH rim (ft) | Proposed Diameter (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Moss Street Sewer** | | | | | | | | | | | |
| 4508 | 4519 | 0.67 | 310.7 | 0.386 | 2.75 | 0.926 | 4.13 | 4.1 | 2.1 | 21.2 | 1.25 |
| 4519 | 4529 | 0.67 | 324.8 | 0.413 | 2.20 | 0.924 | 3.29 | 3.7 | 1.5 | 17.5 | 1.25 |
| 4529 | 4536 | 0.67 | 322.7 | 0.397 | 1.68 | 0.924 | 2.52 | 4.0 | 1.0 | 16.3 | 1.25 |
| 4536 | 4551 | 0.67 | 345.0 | 0.409 | 1.10 | 0.924 | 1.65 | 3.7 | 0.4 | 14.7 | 1.25 |
| **Total** | | | **1303.2** | | | | | | | | |
| **Colorado Street Sewer** | | | | | | | | | | | |
| 4328 | 4277 | 1.25 | 497.6 | 0.301 | 1.46 | 3.570 | 1.23 | 1.6 | 0.2 | 10.2 | 1.50 |
| 4277 | 4243 | 1.30 | 443.4 | 0.318 | 1.53 | 3.570 | 1.45 | 2.2 | 0.2 | 10.0 | 1.50 |
| 4243 | 4189 | 1.25 | 372.6 | 0.279 | 1.88 | 3.571 | 1.51 | 4.5 | 0.6 | 8.3 | 1.50 |
| **Total** | | | **1313.6** | | | | | | | | |
| **Main Street Sewer**[1] | | | | | | | | | | | |
| 5127 | 5126 | 0.83 | 326.0 | 0.359 | 0.57 | 1.051 | 1.09 | 0.0 | | 6.7 | 1.25 |
| 5126 | 5125 | 0.83 | 344.0 | 0.206 | 0.91 | 1.051 | 1.09 | 3.1 | 0.1 | 5.6 | 1.25 |
| 5125 | 5124 | 0.83 | 314.5 | 0.556 | 0.49 | 1.051 | 1.53 | 0.0 | | 6.7 | 1.25 |
| 5124 | 5123 | 0.83 | 8.5 | 2.107 | 1.28 | 2.169 | 1.53 | 4.1 | 0.4 | 7.7 | 1.25 |
| 5123 | 5122 | 1.26 | 362.5 | 0.306 | 1.18 | 3.554 | 0.94 | 0.0 | | 6.9 | 1.50 |
| 5122 | 5121 | 1.25 | 350.5 | 0.924 | 0.71 | 3.553 | 2.00 | 0.0 | | 8.5 | 1.50 |
| 5121 | 5119 | 1.25 | 310.5 | 0.209 | 2.50 | 4.410 | 2.00 | 6.5 | 1.3 | 8.0 | 1.50 |
| 5119 | 5118 | 1.25 | 345.0 | 0.278 | 1.71 | 4.410 | 1.37 | 3.8 | 0.5 | 7.4 | 1.50 |
| 5118 | 5117 | 1.25 | 415.5 | 0.402 | 1.20 | 4.409 | 0.96 | 0.0 | | 6.9 | 1.50 |
| 5117 | 5116 | 1.25 | 411.5 | 0.515 | 0.99 | 4.416 | 0.80 | 0.0 | | 6.8 | 1.50 |
| 5115 | 5114 | 1.25 | 400.0 | 0.880 | 0.79 | 4.430 | 0.68 | 0.0 | | 7.7 | 1.50 |
| 5114 | 5113 | 1.25 | 402.0 | 0.878 | 0.85 | 4.412 | 0.68 | 0.0 | | 7.2 | 1.50 |
| 5113 | 5112 | 1.25 | 398.1 | 0.869 | 0.79 | 4.534 | 1.43 | 0.0 | | 7.6 | 1.50 |
| 5112 | 5111 | 1.25 | 400.1 | 0.597 | 1.78 | 4.440 | 1.85 | 2.1 | 0.5 | 6.7 | 1.50 |
| 5111 | 5110 | 1.25 | 277.0 | 0.357 | 2.31 | 4.435 | 1.85 | 3.9 | 1.1 | 6.1 | 1.50 |
| 5110 | 5109 | 1.25 | 109.5 | 0.356 | 2.01 | 4.516 | 1.61 | 4.5 | 0.8 | 6.7 | 1.50 |
| 5109 | 5107 | 1.25 | 392.6 | 0.316 | 1.87 | 4.516 | 1.49 | 5.0 | 0.6 | 6.9 | 1.50 |
| 5107 | 5106 | 1.25 | 399.5 | 0.721 | 0.86 | 4.507 | 0.69 | 0.0 | | 7.2 | 1.50 |
| 5106 | 5144 | 1.48 | 429.6 | 0.505 | 1.29 | 7.555 | 0.88 | 0.0 | | 7.1 | 1.75 |
| 5144 | 5155 | 1.50 | 235.3 | 0.472 | 1.31 | 7.554 | 0.87 | 0.0 | | 7.4 | 1.75 |
| **Total** | | | **6632.4** | | | | | | | | |
| **Center Street Sewer** | | | | | | | | | | | |
| 5298 | 5314 | 1.00 | 629.9 | 0.024 | 1.12 | 0.922 | 1.12 | 3.4 | 0.1 | 9.9 | 1.25 |
| 5300 | 5298 | 1.00 | 34.5 | 0.261 | 1.04 | 0.616 | 1.12 | 1.8 | | 9.9 | 1.25 |
| **Total** | | | **19162.8** | | | | | | | | |

1) If the City implements a planned diversion of flows from the Main Street Trunk Sewer to the Salt Creek Interceptor, the identified Main Street Sewer improvements may not be required